

ECOSYSTEM STATUS INDICATORS

Ecosystem or Community Indicators

Total catch-per-unit-effort of all fish and invertebrate taxa in bottom trawl surveys

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Description of index: The index provides a measure of overall abundance of demersal and benthic species. Average catch-per-unit-effort of all fish and invertebrate taxa captured by standardized bottom trawl surveys in the Eastern Bering Sea (EBS) and Gulf of Alaska (GoA) was estimated. Spatial and temporal patterns in total CPUE of all taxa combined were modeled using Generalized Additive Models (GAM) as a function of depth, location, Julian day, and area swept following Mueter & Norcross (2002). Although catches were standardized to account for the area swept by each haul we included area swept in the model because of differences in catchability of certain taxa with changes in net width (Dave Somerton, pers. comm.) and because there was strong evidence that total CPUE tends to decrease with area swept, all other factors being constant. The model for the EBS further included bottom temperatures, which appeared to strongly reduce CPUEs at low temperatures ($< 1^{\circ}\text{C}$). At present, it is not clear whether this effect is due to actual changes in abundance or temperature-dependent changes in catchability of certain species. The index did not account for gear differences which may affect results prior to 1988 in the Bering Sea because they are strongly confounded with interannual differences. Total CPUE over time was computed separately for the eastern and western GoA because of large differences in species composition and because no survey was conducted in the eastern GoA in 2001. CPUE in the GoA for the 1984 and 1987 surveys were not estimated because a large portion of these surveys used non-standard gear types. Trends in CPUE over time in the eastern GoA were highly uncertain due to large differences in sampling dates among years and are not presented here.

Status and trends: Total survey CPUE in the western GoA first peaked in 1993/96 and decreased significantly between 1996 and 1999 (Figure 109). CPUE increased again from 2001 to 2003, which had the highest observed CPUE value of the time series. Total CPUE in the EBS has undergone substantial variations and peaked in 1994 (Figure 110), similar to the GoA. There was an apparent long-term increase in CPUE from 1982-2003 (Generalized least squares regression with first-order autocorrelated errors: slope = 0.014 per year, $t = 1.74$, $P = 0.097$). However, estimated means prior to 1988 may be biased due to unknown gear effects. Log-transformed CPUE in the EBS was near the long-term mean from 2000-2002 and, similar to the GoA, increased in 2003/2004.

Factors causing observed trends: Commercially harvested species account for over 70% of the survey catches. Therefore fishing is expected to be a major factor determining trends in total survey CPUE, but environmental variability is likely to account for a substantial proportion of overall variability in CPUE through variations in recruitment and growth. The increase in survey CPUE in the EBS from 2002 to 2003/04 primarily resulted from increased abundances of walleye pollock and a number of flatfish species (arrowtooth flounder, yellowfin sole, rock sole, and Alaska plaice). The increase in the GoA between 2001 and 2003 was largely due to a substantial increase in the abundance of arrowtooth flounder, which accounted for 43% of the total survey biomass in 2003.

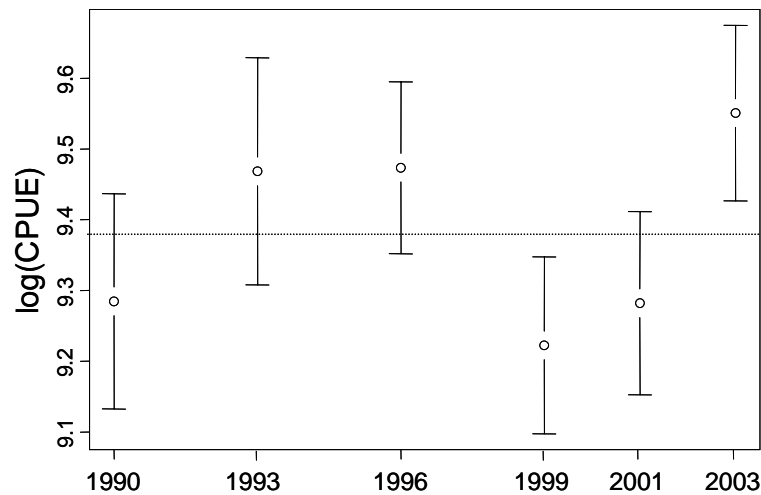


Figure 109. Model-based estimates of log(CPUE) for all fish and invertebrate taxa captured in bottom trawl surveys from in the western Gulf of Alaska (west of 147° W) by survey year with approximate 95% confidence intervals. Estimated means were adjusted for differences in depth, day of sampling, area swept and sampling locations among years.

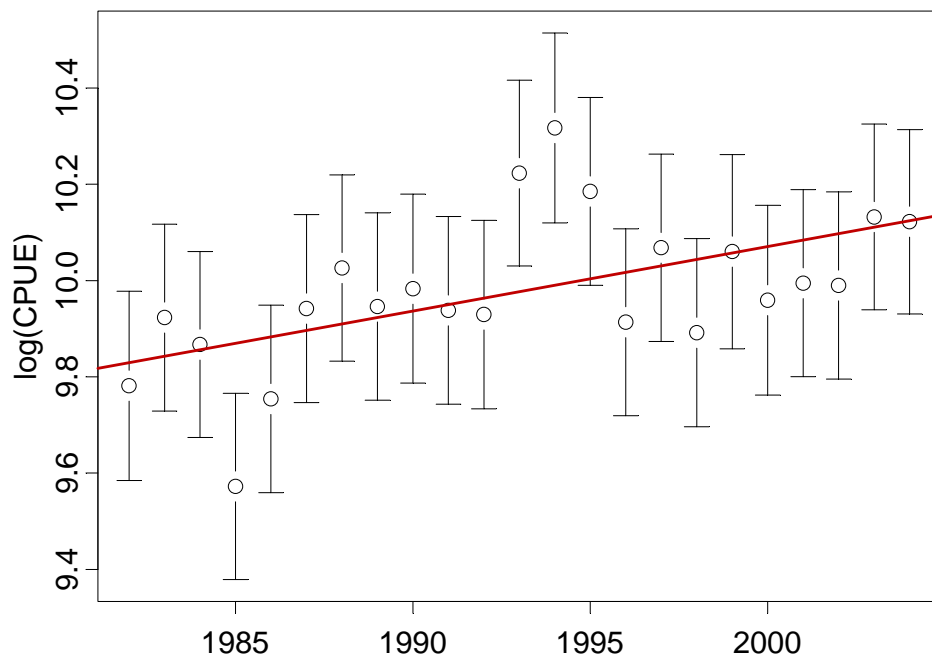


Figure 110. Model-based estimates of total log(CPUE) of all fish and invertebrate taxa captured in bottom trawl surveys from 1982 to 2004 in the Bering Sea with approximate pointwise 95% confidence intervals and long-term linear trend. Estimates were adjusted for differences in depth, bottom temperature, day of sampling, area swept, and sampling location among years. Gear differences prior to 1988 were not accounted for.